REMARKS

Claims 1- 20 are currently pending. By this Amendment, claims 1 and 15 are amended, no new claims have been added, and no claims have been cancelled.

The present invention relates to a method of processing image data to compensate for errors in motion vectors that occur, for example, as a result of transmission, recording or storage. The method of the present invention, as defined in claim 1, therefore provides an approximation of a lost or damaged motion vector, for use in concealment of a corrupted macro block.

The lost or damaged motion vector for the image block is derived from a first set of vectors from motion vectors of: (i) neighboring blocks in the same frame and (ii) the corresponding block and its neighboring blocks in one or more preceding and/or subsequent frames. A set of candidate vectors is derived from the motion vectors of one or more of (i) and (ii) of the first set of vectors. The candidate vectors are analyzed by comparing the motion vectors to determine similarity of motion, as discussed below, and one of the candidate vectors is selected on the basis of the analysis.

Thus, one of the candidate vectors, which are taken from the motion vectors for blocks which neighbor the image block of interest either spatially and/or temporally, is selected. The selection in based on an analysis of motion vectors to ascertain the most likely of the candidates to have similar motion to the true motion vector of the block of interest.

I. Claim Rejections under 35 U.S.C. §101

The Examiner has rejected claims 1-16 under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter as follows. Claim 15 defines a computer program embodying functional descriptive material. However, the claim does not define a computer-readable medium of memory and is thus non-statutory for that reason.

In accordance with clarifying the claimed invention and emphasizing such clarity pursuant to statutory subject matter, claim 15 has been amended to recite a computer-readable medium storing instructions that, when executed, perform a method as claimed in claim 1.

Accordingly, it is respectfully asserted that the amendment to claim 15 obviates the rejection of claims 1-16 under 35 USC § 101.

Accordingly, Applicants respectfully request the withdrawal of the rejection of claims 1-16 under 35 U.S.C. § 101.

II. Claim Rejections under 35 U.S.C. §102 and §103

The Examiner has rejected claims 1-7 and 10-13 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,781,249 to Hwang; and rejects claims 1-11 and 17-19 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,865,227 to Chan; and rejects claims 1 and 15-17 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,690,730 to Choi; and rejects claim 1 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,596,370 to Jung; and rejects claim 1 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,724,823 to Rovaiti et al. (hereinafter "Rovaiti"); and rejects claims 1-14 and 17 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,947,603 to Kim; and rejects claim 20 under 35 U.S.C. § 103(a) as being unpatentable over Kim in view of U.S. Patent No. 6,782,053 to Lainema. These rejections are respectfully traversed.

US-A-5,781,249 *(Hwang)* describes a method for determining a motion vector of a search block included in a search frame of the video signal. The motion vector is determined by either selecting among the motion vectors of processed neighboring blocks (which, as the Examiner recognizes, is similar to the present invention) or *by* using full search block matching.

In *Hwang,* the selection among the motion vectors of processed neighboring blocks is performed in Candidate Vector Deciding Block 120, which selects an x-vector and a y-vector among the neighboring vectors, whose horizontal and vertical component is closest to zero (see column 4, lines 51 to 58). Detection Block 130 receives a predicted block based on the three candidates (the x-vector, the y-vector and a 0 vector), and selects from the three candidate vectors, one with a minimum distortion (see column 5, lines 7 to 27 and lines 35 to 47). Thus, selection of the motion vector from neighboring blocks is based on *similarity of image data,* by comparison or the image data of the search block and candidate predicted blocks. Selection

is not based on *similarity of motion,* by comparison of motion vectors, as in the present invention, as defined in amended claim 1.

Similarly, full search block matching involves the *comparison of image data* of the block with candidate, similarly sized blocks in a previous frame, as described from column 1, line 56 to column 2, line 13. Thus, again, selection is not based on *similarity of motion,* by comparison *of motion* as represented by vectors, as in the present invention, as defined in amended claim 1.

Accordingly, *Hwang* does not at least anticipate analyzing and selecting one of the candidate vectors by "comparison of motion vectors to determine similarity of motion" as recited in amended claim 1. As such Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Hwang,* and accordingly claims 6-7 and 10-13, which depend from independent claim 1 are similarly patentably distinct for at least the same reasons asserted above, as well as the additional recitations contained therein. Applicants respectfully request the withdrawal of the rejection of claims 1-7 and 10-13 under §102 over *Hwang.*

US-B-6,865,227 *(Chan)* describes a method for concealing errors in video data. The method includes decoding a 1st set of motion vectors (MVs) and estimating a 2nd set of remaining MVs in corrupted video packet. The estimation of the corrupted MVs is carried out *by averaging the MYs of uncorrupted neighboring MYs* (see column 3, lines 42 to 46). A candidate MV set is created by combining the decoded MVs up to a particular point (e.g. macro block location of the detected error) and estimated MVs after that point. This candidate MV set is then used to perform motion compensated temporal replacement of the texture data and is then evaluated under an "image smoothness" test (see column 3, lines 50 to 63). The creation of the candidate MV set and smoothness measure is repeated after moving the particular point further to the beginning of the motion partition in the video packet. A motion vector set with best smoothness measure is selected to replace the corrupted MVs (see column 4, lines 28 to 30). Also, the MV set maybe further processed in a reverse order to recover some of the macro blocks that were estimated but are uncorrupted. The image smoothness measure is carried out spatially (between current macro block and surrounding neighboring

macro blocks) or temporally (between surrounding region of current macro block and motion compensated temporal replacement of the surrounding region in the previous frame).

Thus, *Chan uses an estimated (e.g.* average) *motion vector as the replacement motion vector* for a particular image block and does not *select from candidate motion vectors of spatially and/or temporally neighboring blocks,* as in the present invention.

Accordingly, *Chan* does not anticipate *"deriving a set of candidate vectors from* one or more of motion vectors of neighboring blocks in the same frame, and the corresponding block and its neighboring blocks in one or more preceding and/or subsequent frames"; "analyzing said ... vectors", and *"selecting one of the candidate vectors* on the basis of the analysis, wherein analyzing and selecting involves comparison of motion vectors to determine similarity of motion", as recited in amended claim 1. As such Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Chan,* and accordingly claims 2-11 and 17-19, which depend from independent claim 1 (either directly or by incorporation into independent claim 15) are similarly patentably distinct for at least the same reasons asserted above, as well as the additional recitations contained therein. Applicants respectfully request the withdrawal of the rejection of claims 2-11 and 17-19 under §102 over *Chan.*

US-B-6,690,730 *(Choi)* describes a method for estimating motion during image compression, and is not concerned with approximating a motion vector for an image block for concealment of a lost or damaged motion vector, as in the present invention. Thus, the method is typically utilized in an encoder, instead of a decoder.

Choi provides a hierarchical motion estimation method comprising three layers (lower layer, middle layer and upper layer). An image of a lower layer is sub-sampled, generating a sub-sampled image of a middle layer and a sub-sampled image of an upper layer. Next, the Sum of Absolute Differences (SAD) is calculated with respect to the sub-sampled image of the upper layer to select the initial search area candidates from the image of the middle layer. This process is carried out to the lower layer, until a final Motion Vector (MV) at a position having a minimum SAD is obtained for image of the lower layer. Calculations of a SAD is performed on a 16x16 block in the lower layer, a 8x8 block in a middle layer and a 4x4 block in

the upper layer. In addition, a search is performed in units of +4 pixels in the upper layer and ±2 pixels in the middle and lower layers.

Thus, *Choi* uses a hierarchical method in which each image layer is sub-sampled to generate the subsequent layer. However, in a method of approximating a motion vector for the purpose of concealment, only one layer is present, as in the present invention. Moreover, *Choi* does not teach nor disclose the combination of features of the present invention, as recited in amended claim 1. Indeed, the passages at column 9, lines 28 to 30 and 39 to 47 cited by the Examiner merely discloses the identification of *an initial search point in* the image data, using the interrelation between peripherally neighboring macro blocks in one layer, *to start searching in another layer.* This is quite different from selecting one of a number of candidate motion *vectors,* from spatially and/or temporally neighboring blocks based on similarity of motion, as an approximation of a corrupted motion vector for an image block, as in the present invention.

As such, Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Choi,* and accordingly claims 15-17, which depend from independent claim 1 are similarly patentably distinct for at least the same reasons asserted above, as well as the additional recitations contained therein. Applicants respectfully request the withdrawal of the rejection of claims 1and 15-17 under §102 over *Choi.*

US-A-5,596,370 *(Jung)* describes a method of determining motion vectors by using a boundary matching technique. Candidate blocks are identified by comparison of image data, and an error function is calculated between the image data in a search block from the current frame and image data in candidate blocks from a previous frame (see column 3, lines 27 to 47). All the error functions are compared to each other and the candidate blocks with the M (e.g. M=3 in the example) smallest error functions are selected with their corresponding M displacement vectors (see column 3, lines 55 to 650. The optimum motion vector is determined out one of the M disablement vectors, which has the lowest block boundary measurement, which is determined by comparison of boundary pixels (the column 4, lines 1 to 23).

Thus, the candidate blocks, and corresponding displacement vectors, used *in Jung* are derived using a block matching technique, and are not necessarily spatially or temporally neighboring blocks, as in the present invention. Moreover, the algorithm used in *Jung* evaluates *image texture data* to determine the motion vector, and does not *compare motion vectors* to determine similarity of motion. Moreover, *Jung* uses a boundary matching technique, which compares boundary pixels of *image data* to select a motion vector out of M candidate displacement vectors instead of selecting a motion vector from candidate motion vectors of spatially and/or temporally neighboring image blocks.

As such, Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Jung*. Applicants respectfully request the withdrawal of the rejection of claim 1 under §102 over *Jung*.

US-B-6,724,823 *(Rovati)* discloses a VLSI architecture, including a motion estimation (ME) engine, configured to process a cost function and identify a motion vector which minimizes a cost function (e.g. SAD, MAD or MSE). *Rovati* is not concerned with approximating a motion vector for an image block for concealment of a lost or damaged motion vector, as in the present invention. The method of *Rovati has a* predictive phase and a refinement process. First, in the predictive phase, the motion vectors of spatially neighboring blocks (four neighboring blocks) or spatially and temporally neighboring blocks (two spatial neighbors and three temporal neighbors) are tested and the motion vector that minimizes a cost function (e.g. MAD) is chosen. Second, in the refinement process, the vector chosen as the best predictor (VO) is used for further refinement. In the refinement process, the MAD (VO) is compared with a threshold (TH1). If it is lower, then VO is chosen as the final MV and the search stops; otherwise, an exhaustive search in 3x3 pixel grid, centered on VO is performed.

Thus, *Rovati* selects a motion vector that *minimizes a cost function (e.g.* MAD, see column 7, lines 5 to 10). There is no teaching nor disclosure or of *comparing motion vectors* and selecting the motion vector based on similarity of motion. This difference is primarily due to the fact that *Rovati* is not concerned with concealment of a lost or damaged motion vector

for an image block.

As such, Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Rovati*. Applicants respectfully request the withdrawal of the rejection of claims 1 under §102 over *Rovati*.

US-B-6,947,603 *(Kim)* describes a motion estimation technique similar to that *of Hwang,* and the present invention is distinguished over this document for corresponding reasons. In particular, *Kim* derives a set of three candidate motion vectors from a 0 motion vector, a median of motion vectors of calculated neighboring blocks, and the previous motion vector of the same block (see column 3, line 63 to column 4, line 27). A vector is selected from the candidates having the minimum SAD (see column 4, lines 38 to 41) and compared with the threshold, which comparison determines which of the algorithm is then selected (OPGS or HSBMA). The selected algorithm is then used for motion estimation.

Thus, the method disclosed *in Kim,* does not involve selection of a motion vector from among the motion vectors of spatially and/or temporally neighboring blocks. Moreover, the motion vector is not selected based on a comparison of the motion vectors to determine *similarity of motion, as in* the present invention, as defined in amended claim 1.

As such Applicants respectfully assert that at least independent claim 1 in patentably distinct from *Kim,* and accordingly claims 2-14 and 17, which depend from independent claim 1 (either directly or by incorporation into independent claim 15) are similarly patentably distinct for at least the same reasons asserted above, as well as the additional recitations contained therein. Applicants respectfully request the withdrawal of the rejection of claims 1-14 and 17 under §102 over *Kim.*

Obviousness

None of the techniques for motion estimation described in the prior art documents use the combination of features now recited in amended claim 1. More specifically, none of the documents discloses approximating a motion vector for an image block by deriving and analyzing a set of motion vectors of spatially and/or temporally neighboring image blocks, and selecting one of the motion vectors as the approximation, in which the analyzing and selecting

involves comparison of motion vectors to determine similarity of motion.

As discussed above, since the selection is based on a comparison of motion vectors, the processing can be made relatively simple. Moreover, because the selection involves an analysis of the temporally and/or spatially neighboring vectors, to determine which has the closest similarity of motion to the estimated vector, the results are more accurate than in prior art techniques.

Claim 20 is rejected over the combination of Kim in view of Lainema, under U.S. 35 § 103(a). This rejection is respectfully traversed.

For at least the reason asserted above, with regard to Kim, the combination of Kim in view of Lainema, fails to provide what is lacking in Kim, and accordingly the Applicants respectfully assert that the Examiner has failed to meet his burden under a *prima facie* case of obviousness. As such, Applicants respectfully request the withdrawal of the rejection of claim 20 under § 103 and the combination of Kim and Lainema.

For these reasons, it is submitted that the present invention as defined in amended claim 1 is patentable over the prior art references.

The subject matter of the dependent claims 2 to 14 is patentable at least by virtue of their dependency upon claim 1. Moreover, the subject matter of claims 15 through 20, which recite corresponding subject matter to claim 1, meet the requirements of patentability for similar reasons.

III. Conclusion

In view of the above remarks, it is believed that claims are allowable.

Should there be any outstanding matters that need to be resolved in the present application; the Examiner is respectfully requested to contact William D. Titcomb Reg. No. 46,463 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

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